Attorney's Docket No. 042390P6126D

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Makarem A. Hussein

Application No. 09/672,375

Filed: September 28, 2000

For: **A Process to Manufacture Continuous Metal Interconnects**

Examiner: Douglas W. Owens

Art Unit 2811

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AMENDED REPLY BRIEF

Appellant submits, in triplicate, the following Reply Brief pursuant to 37 C.F.R. §1.193(d) for consideration by the Board of Appeals and Interferences ("Board"). This Reply Brief is responsive to the Examiner's Answer of April 10, 2003.

Appeal Brief's Arguments Stand

Appellant believes that the arguments of the Appeal Brief filed January 30, 2003 are still valid. Thus, this document will address some of the errors and new issues raised by the Examiner's Answer.

Arguments

I. Initial Matter

Appellant has found it remarkably difficult to discern what exactly the Examiner is attempting to argue in numerous sections of the Answer. This is due to the fact that the statutory grounds of rejection are 35 U.S.C. §102(e) (anticipation), but what the Examiner appears to be arguing in the Answer to Appeal Brief is that the claims are rejected because steps not explicitly stated in the reference would have been known to

rejected because steps not explicitly stated in the reference would have been known to one having skill in the art (*e.g.*, a 35 U.S.C. 103(a) obviousness rejection). Thus, as will be explained further below, it appears to Appellant that the statutory basis of the rejection has been improperly changed (see MPEP §1208.01; 37 CFR §6193(a)(2)). In one small example, the Examiner states,

> Obeng et al. does not explicitly state that a portion of the self-assembling organic passivation film (18) is removed, as shown in Fig. 1(d), which would enable the upper copper layer to directly contact the lower copper layer. (Examiner's Answer, page 6, lines 7-9) [Emphasis added]

Then, in that same paragraph the Examiner states,

> Additionally, since the scope of the invention is to produce an interconnect structure and not a series of capacitors, one having skill in the art would have known to remove the dielectric material before depositing a conductor (20) on the first conductor (20/22) as shown in the final structure (Fig. 1(d)). (Examiner's Answer, page 6, line 19 through page 7, line 1) [Emphasis added]

Nevertheless, to the best of its ability, Appellant has attempted to address the Examiner's intent and respond herein.

II. Group I Claims

The Examiner states that,

> When the state of the art is considered, the written disclosure and drawings of Obeng et al. are in full agreement with each other and disclose the invention of the instant application. (Examiner's Answer, page 5) [Emphasis added]

Appellant will describe in detail below why Figures 1(*c*) and 1(*d*) of Obeng are vague and not consistent with the text. However, at this point, Appellant will point out that the above statement by the Examiner cannot be true. Specifically, Figures 1(*b*), 1(*c*), and 1(*d*) of Obeng are not even in full agreement with each other, as can be seen by layer 18 and the thick dark line seed layer formed in and capped by layer 20 in the via shown on the right hand side of Figure 1(*b*) (and as described in the corresponding portions of the specification) but omitted form the same locations in Figures 1(*c*) and 1(*d*)). Thus, even a cursory review shows that the figures are clearly inconsistent because once barrier layer 18 and the dark line copper seed layer are sealed below

copper layer 20 in the via, they could not be removed, and therefore would naturally exist in Figures 1(*c*) and 1(*d*).

The Examiner also states,

> Obeng et al. further discloses in lines 25-29 of the same column, that a CMP (chemical-mechanical-polish) step is performed, stopping at the oxide layer (10), which also exposes the copper layer (22), as shown in Fig. 1(c). The Applicant also cites Col. 4, lines 33-35, where Obeng et al. discloses that "...The above steps may then be repeated as required to form a device having multilevel interconnections as in Fig. 1(d)", asserting that, since Obeng does not explicitly state that the lower copper layer is exposed to the upper copper layer, that it is not the intention of the invention to have the copper structures contact each other. (Examiner's Answer, page 5) [Emphasis added]

First, Appellant clarifies that its reading of Obeng is that the chemical-mechanical-polishing step which exposes layer 22 shown in Figure 1(*c*) is performed prior to deposition of layer 24, as shown in Figure 1(*c*), and subsequent formation of the upper level shown in Figure 1(*d*) in accordance with the structure shown in Figure 1(*b*) and the corresponding description in the specification. Therefore, layer 24 should exist in Figure 1(*d*), between the entire lower level and upper level (*e.g.*, including in the bottom of the via in the upper left hand side of Figure 1(*d*)), similarly to as shown in Figure 1(*c*).

Next, the Examiner mischaracterizes Appellant's point. The point is that the text in Obeng describes, and the figures should also show forming barrier film 18 (Figure 1(*b*) and corresponding text), a copper seed layer (Figure 1(*b*) and corresponding text), and film 24 (Figure 1(*c*) and corresponding text), between any lower layer and any upper copper layer 20 (*e.g.*, as shown in Figure 1(*b*)); because nowhere does Obeng teach or describe removing any of those layers from within any portion of a trench or via, as noted in Appellant's Appeal Brief (Appeal Brief, page 5). Specifically, in going from Figure 1(*c*) to Figure 1(*d*), the only description provided in Obeng is that the steps described above in Obeng be repeated. Hence, the trench and via shown in the upper left hand side of Figure 1(*d*) would necessarily include barrier film 18 and a copper seed layer as shown in Figure 1(*b*), as well as spontaneous self-assembling film 24, as shown in Figure 1(*c*).

Moreover, the assertion above that Appellant states that it is not the intention of the invention to have copper structures contact each other is also inaccurate. In fact, Appellant's Brief does not mention the "intention of the invention" of Obeng, but instead points out what the description of what Obeng includes and does not include. Moreover, as the Examiner admits and Appellant is well aware, an object of the invention in Obeng is "to prevent the migration of copper to the underlying substrate" and "to protect the copper from air corrosion." (Examiner's Answer, page 7, lines 3-4, and page 10, lines 1-4)

Therefore, barrier film 18, copper seed layer, and film 24 should be shown in the inaccurate portions of Figures 1(*c*) and 1(*d*) as governed by the initial clear written description and corresponding Figure 1(*b*) describing and showing their formation and capping with layer 20, but not describing or showing their removal (Obeng, col. 4, lines 9-35, Figure 1(*b*)).

Next, the Examiner admits that Obeng does not explicitly state that a portion of barrier film 18 is removed (*e.g.*, as incorrectly shown in Figures 1(*c*) and 1(*d*)) to enable an upper copper layer to directly contact a lower copper layer. Specifically, the Examiner states,

> Obeng et al. does not explicitly state that a portion of the self-assembling organic passivation film (18) is removed, as shown in Fig. 1(d), which would enable the upper copper layer to directly contact the lower copper layer. Leaving the self-assembling organic film between the lower copper structure and upper copper structure would have been outside of the spirit and scope of the disclosed invention. the self-assembling organic film is disclosed as having an organic compound having the formula $X[CH_2(Ch_2)n–O–C(O)CH_2C(O)CH_3]_2$, wherein X is S (sulfur), Si (silicon), or N (nitrogen) and n is from 2 to 18 (Col. 2, lines 65 and 66). The self-assembling organic film would have been an insulator having dielectric properties, as opposed to being another layer of conductive material. In leaving this dielectric material between the layers of copper, capacitance would have been introduced into the interconnect structure resulting in a significant RC time delay, the very thing that is undesirable in interconnect structures (See Col. 1, lines 12-14). Additionally, since the scope of the invention is to produce an interconnect structure and not a series of capacitors, one having skill in the art would have known to remove the dielectric material before depositing a conductor (20) on the first conductor (20/22) as shown in the final structure (Fig. 1(d)). The self-assembling organic film can be easily removed by plasma/wet etch

processing (Col. 2, lines 60 and 61). (Examiner's Answer, pages 6 and 7) [Emphasis added]

This is another instance where the Examiner appears to have stepped outside of the §102 statutory basis for the rejection, and instead relies on what "one having skill in the art would have known" with respect to performing processes and steps not described within the cited reference. (MPEP §1208.01; 37 CFR §1.193(a)(2)) As such, the new ground of rejection is impermissible as a matter of law because it does not comply with the statutory §102 standards.

In addition, Appellant asserts that one having ordinary skill in the art would not go against what is shown in Figure 1(b) and described in the corresponding text and attempt to perform some unknown process to remove barrier film 18 and the copper seed layer from only the bottom of the via after the film and seed layer are capped and sealed there by copper layer 20, but would consider omission of film 18 and possibly the seed layer from portions of Figures 1(*c*) and 1(*d*) as errors in the drawings.

Pointedly, while the Examiner is arguing that one skilled in the art would have interpreted Figure 1(*c*) (without any corresponding text) to include a process for removing diffusion layer 18, and possibly the copper seed layer from the bottom of the via only, and would interpret Figure 1(*d*) (also without any corresponding text) to include the process described above, as well as a process for removing barrier layer 18, removing the copper seed layer, and removing film 24 from the bottom of the via on the left hand side of Figure 1(*d*), such an interpretation is not possible because the formation of barrier film 18 and the copper seed layer existing sealed under copper layer 20 is shown in Figure 1(*b*) and described in the corresponding portion of the specification, and there is no description for removal of barrier film 18 or the copper seed layer, and Figures 1(*c*) and 1(*d*) show the result of subsequent processes performed on the structure of Figure 1(*b*).

Furthermore, where necessary, Obeng does describe removing copper layer 20, barrier layer 18, and the copper seed layer (Obeng, col. 4, lines 26-30). Thus, Obeng does not leave it up to a practitioner in the art to determine when and where film 18 and the copper seed layer should be removed, but specifically points out how and

where to remove them when desired (*e.g.*, in this case from the upper surfaces of Figure 1(*b*)). Therefore, a practitioner would not assume that something described and shown as disposed has been removed and the Examiner's improper §103 assertion is misplaced because removal of such layers is described in Obeng, and the removal of portions of layers that the Examiner asserts would necessarily be removed, would have been described in Obeng if desired.

Moreover, with respect to the bottom of the via on the left hand side of Figure 1(*d*), that via is formed in accordance with the structure of Figure 1(*b*) and the corresponding description in the specification. Therefore, that left hand side via would also include barrier film 18 and a copper seed layer at the bottom of the via. In addition, that left hand side via is formed over the structure of Figure 1(*c*) and there is no description of removing film 24 from the bottom of the via. Therefore, the via on the left hand side of Figure 1(*d*) would include at least barrier film 18, a copper seed layer, and film 24 at the bottom of the via. In other words, the Examiner argues that after barrier film 18 and the copper seed layer are described as being formed and being capped and sealed under copper layer 20, a practitioner in the art would interpret the subsequent figures where at least one of those layers appears omitted to mean that Figure 1(*b*) and the corresponding written description which show and describe those layers sealed under copper layer 20 are, in fact, in error.

On the other hand, Appellant finds Figures 1(*c*) and 1(*d*) inconsistent with Figures 1(*b*) and the corresponding written description which describe formation of barrier film 18 and a copper seed layer sealed below copper layer 20, do not describe removing either barrier film 18 or the copper seed layer, which show and describe barrier film 18 and the copper seed layer disposed between copper layer 20 and the structure below in the primary figure related to capping with copper layer 20, which is Figure 1(*b*).

Therefore, Appellant asserts that a practitioner in the art would not assume that barrier film 18 or the copper seed layer shown in Figures 1(*b*) and described as disposed as shown in Figure 1(*b*) would be removed from only the bottom of the via shown in Figures 1(*b*) by some unknown process after they are sealed under copper layer 20, just because barrier film 18 and the seed layer are not shown in Figures 1(*c*) and 1(*d*)

(although Appellant believes that the copper seed layer is shown in the bottom of the via in Figures 1(*c*) and 1(*d*)). Instead, a practitioner in the art would presume that Figures 1(*c*) and 1(*d*) are in error or are incomplete because the initial and only text describing the formation of barrier film 18 and the copper seed layer, and capping thereof with copper layer 20, and properly illustrated corresponding Figure 1(*b*), are full, clear, concise, and exact descriptions.

Moreover, given the Examiner's argument quoted above, the broadest §102 consideration as an "inherence" argument, Appellant also disagrees. Specifically, it would not be inherent to remove either film 24, the copper seed layer, or barrier film 18 form the bottom most portion of a via and trench in Obeng, because such removal is not necessary. For instance, the Examiner admits, the via and trench could be capped with copper layer 20 (*e.g.*, as shown in Obeng Figure 1(*b*)) while "leaving this dielectric material [film 18] between the layers of copper" (Examiner's Answer, page 6, lines 15-19; also see page 8, lines 9-11; and page 12, lines 3-5, which allow for the possibility and function of such a structure.)

Moreover, the Examiner does not even provide a proposed method or set of processing steps for removing either film 24, the copper seed layer, or barrier film 18 from the bottom of a via without removing it from the via sidewalls, trench sidewalls, and/or trench bottom surfaces. In addition, the Examiner does not provide any process, method, motivation, or description for removing either the copper seed layer, or barrier film 18 once they are sealed below copper layer 20.

Furthermore, Appellant disagrees that the structure shown in Figure 1(*b*), and described clearly in col. 4, lines 21-35 of the specification (*e.g.*, including barrier layer 18 and the copper seed layer between an upper copper layer 20 and any layer below) is "outside the spirit and scope of the disclosed invention," as asserted by the Examiner. For example, in many places throughout the specification, Obeng describes providing a passivating layer on the surface of and under copper layers. (Abstract, lines 3 and 7; specification col. 2, lines 27-31; col. 3, lines 8-10; and col. 3, lines 23-25). In fact, Obeng describes "these films form a densely packed two dimensional layer (usually a mono-layer) on the copper or underlying surface." (Col. 3, lines 8-10) [Emphasis added]

Obeng also describes exposing the copper to a solution for several hours in order to form such a film on the copper. (Col. 3, lines 52-54)

Pointedly, independent claims 1 and 5 of Obeng specify "a protective film located over the metallic copper layer." [Emphasis added] This shows that Obeng not only describes but provides claim limitations to protect a layer of protective film over metallic copper (*e.g.*, such as passivation film 18 over copper 20 at the bottom of the trench and via filmed with copper 20, as should be shown in via on the left hand side of Obeng Figure 1(*d*)). Likewise, dependent claim 8 also requires "a barrier layer underlying said copper interconnects, said barrier layer consisting essentially of a self-assembled organic film." [Emphasis added] Thus, claim 8 makes it clear that a barrier layer is contemplated below the copper interconnects (*e.g.*, such as barrier layer 18 between copper layer 20 and any copper structure therebelow). Moreover, independent claim 5 also includes "and that includes a self-assembled organic passivating film on the surface of said copper interconnects." [Emphasis added] Here, in addition to the protective film, claim 5 requires a self assembled organic film on the surface of the copper (*e.g.*, such as spontaneous self-assembling film 24 formed over copper layer 20 as shown in Figure 1(*c*) and not described as being removed but erroneously omitted from Figure 1(*d*) in Obeng).

Finally, in addressing the Examiner's assertion that it is desirable to remove the self-assembled film from the copper interconnects, Obeng states,

> We have now discovered that these same kinds of films can be employed to provide a passivation layer to prevent air corrosion of copper and more particularly to passivate copper interconnects in ULSI integrated circuits to substantially eliminate corrosion of the interconnects without any detrimental effects to the IC device. (Obeng, col. 2, lines 6-13) [Emphasis added]

Here Obeng describes that the passivation layers can passivate copper interconnects in ULSI [sic] integrated circuits "without any detrimental effects to the IC device."

Finally, with respect to the Examiner's citation to col. 2, line 60 and 61 of Obeng which state,

> Generally, these barrier membranes may be destroyed during subsequent plasma/wet etch processing.

As mentioned above, Appellant fails to see how stating that generally something, may be destroyed, satisfies the §102 standard for removing, from only the bottom of a via, film 24, the copper seed layer and promoter film 18 (*e.g.*, which are formed and shown by film 24 in Figure 1(*c*) and by the copper seed layer and barrier film 18 in Figure 1(*b*)). Moreover, Obeng does specifically describe removal of portions of copper layer 20, as well as the seed layer and barrier layer 18 where desired. For example, at col. 4, lines 26-30 Obeng states,

> The copper layer 20 is then treated in accordance with standard CMP processing, stopping at the oxide layer followed by a post CMP cleaning with CO_2-sparged deionized water, pH~4, in a megasonics agitated system or with brush scrubbing and ending with a structure as shown in FIG. 1(*c*). [Emphasis added]

Although the reference in the quotation above to Figure 1(*c*) is inaccurate (as Figure 1(*c*) includes film 24 which is deposited after the CMP processing and post CMP cleaning), the fact that the description quoted above is included in Obeng is evidence that Obeng contemplates and includes a description of removing copper layer 20, as well as barrier layer 18 and the copper seed layer where desired. In addition, the description quoted above also shows that Obeng did not leave it up to a practitioner in the art to determine when and where copper layer 20, the copper seed layer, or film 18 should be removed, but specifically points out how and where to remove them when desired (*e.g.*, in this case from the upper surfaces of Figure 1(*b*)).

Finally, Appellant points out that the only instance in Obeng of showing and describing capping trenches and vias 16 with thick copper film 20 is Figure 1(*b*) and corresponding text which describes barrier film 18 and a copper seed layer between copper film 20 and the structure therebelow. Moreover, in Obeng the repetition of this process to form the structure in Figure 1(*d*) should include film 24, as shown in Figure 1(*c*), as well as layer 18, and the copper seed layer between copper film 20 and any structure therebelow, as shown in Figure 1(*b*).

Therefore, Appellant asserts that the Examiner's argument quoted above is an improper change in the statutory grounds of rejection, and thus necessitates reopening of the prosecution. In the alternative, Appellant does not believe that a practitioner in the art would not create a non-existent description from the incorrect inaccuracies of Figures 1(*c*) and 1(*d*), but would instead understand the initial clear detailed description text and associated Figures 1(*b*) and 1(*c*). Also, the missing description cannot be inherent as the Examiner himself describes a viable alternative. Finally, the methodology for performing what the Examiner proposes is well known in the art (*e.g.*, removing film 18 and a seed layer from only the bottom of a via) cannot be motivated by the reference because an example of that methodology is not even described by the Examiner.

It is unfortunate that the figures in Obeng (*e.g.*, Figure 1(*d*)) are vague and appear to indicate a structure other than that described by the text of Obeng. However, the Examiner's wish that one having skill in the art would have gone against Figure 1(*b*) and the corresponding text of the reference, does not reverse what the patent does describe, does not cure the inconsistencies of the patent, does not infuse a description in the patent that does not exist and that a practitioner would not assume, and does not make inherent a description that the Examiner admits is not necessary. In other words, if the reference is such a poor one (*e.g.*, has inconsistent figures and only two columns of detailed description), that the Examiner must argue that errors in the figures are the result of taking undescribed steps that a practitioner in the art would know to take (*e.g.*, the incorrect omission of film 18 and the seed layer in Figures 1(*c*) and 1(*d*)), then the Examiner might consider at least explaining how such additional steps could occur or cite a reference describing how such steps might be performed.

Next, the Examiner states that,

> [i]t is clear to one of ordinary skill that Obeng et al. sufficiently discloses that the self-assembling organic layer is not disposed between the circuit device (lower copper structure (22/20)) and the upper copper structure. (Examiner's Answer, page 7) [Emphasis added]

Again, Appellant believes that a practitioner would not assume that something described and shown as disposed between two layers of copper should be removed

and asserts that the Examiner's conclusion here is an attempt to impermissibly enter a new ground of rejection in the Examiner's Answer (MPEP §1208.01; 37 CRF 1.193(a)(2)). The only figure (*e.g.*, Figure 1(*b*)) and corresponding description in the specification of capping a trench and via with thick copper film 20, includes barrier film 18 and a copper seed layer between the upper copper structure and anything therebelow.

The Examiner also asserts that,

> [o]ne having ordinary skill in the art would not have misunderstood the disclosure to mean that a diffusion barrier film should be placed between the lower and upper portions of the copper interconnect structure. (Examiner's Answer, page 7) [Emphasis added]

Again, the Examiner is relying on the erroneous portion of Figure 1(*d*) of Obeng to provide a description that is inconsistent with the initial more fully, more clearly, more concisely, and more exactly described process of making and using the invention of Obeng as provided in the written terms in col. 4, lines 9-35 and shown in Figure 1(*b*). Thus, the Examiner's assertions quoted above are also against what a practitioner in the art would assume, are improper obviousness assertions, cannot provide for inherence, and cannot cure the poor reference.

Further on, the Examiner states,

> On page 6 of the brief, the Applicant argues that "... Obeng only describes thick copper thick copper film 20 capping the seed layer and the barrier film", citing col. 4 at lines 21-24, where a description is given of the *partially fabricated device* of fig. 1(b), where the barrier film has been deposited over the substrate for the expressed purpose of preventing the migration of copper to the underlying substrate (Col. 2, lines 27-31). (Examiner's Answer, page 7) [Emphasis added]

Appellant points out that the device of Figure 1(*b*) corresponds to col. 4, lines 9-25 of the specification and properly shows barrier layer 18 and a copper seed layer in trench and via 16 between capping copper layer 20 and any structure therebelow. Moreover, the device of Figure 1(*b*) and corresponding steps are required for forming subsequent trenches and vias capped with thick copper film 20 (*e.g.*, as described in Obeng at col. 4, lines 33-35). Thus, a practitioner in the art would not assume that some unexplained method should be performed to remove barrier film 18 and the copper seed layer from between capping copper layer 20 and any structure therebelow.

Next, the Examiner states,

> The applicant further asserts that one having ordinary skill would have necessarily and precisely repeated the steps described in lines 21-24 of column4 to form a multi-layered interconnect structure. This would have required one having ordinary skill to provide a film for the prevention of the migration of copper atoms between two copper layers, which would have only introduced capacitance to the line. It would have further required one having skill in the to deposit a thin copper layer on the copper layer before depositing the second copper layer. As discussed above, the barrier film between copper layers is not needed and would have been detrimental to the operation of the interconnect structure. Additionally, the copper seed layer would have only been needed on the sidewalls comprising the organic material. There is no need for a copper seed layer in the bottom of the trench because a copper layer is already there. One having ordinary skill in the art would not misinterpret the specification of Obeng et al. to require a thin layer of copper (used for electroplating) be left on the a layer of copper before depositing a third layer of copper. (Examiner's Answer, page 8) [Emphasis added]

However, Appellant does not assert "that one having ordinary skill would have necessarily and precisely repeated the steps ...," but points out that the only description in Obeng of capping trenches and vias with copper layer 20 requires that the subsequent capping be performed as described with respect to Obeng Figure 1(*b*) and the corresponding text, as described above. Specifically, Obeng states,

> [t]he above steps may then be repeated as required to form a device having multilevel interconnections as shown in FIG. 1(*d*)." (Obeng, col. 4, lines 33-35) [Emphasis added]

Moreover, the Examiner's quote above appears to be another attempt to presume that a practitioner in the art would assume that something should be done different than what is described in the reference because of inaccuracies in the drawings. Further, Appellant asserts that the Examiner's quote above is an impermissible attempt to either argue a new statutory basis of rejection or to cure the defects of the reference. Specifically, for example, the Examiner states "the copper seed layer would have only been needed on the sidewalls comprising the organic material." However, the Examiner has not identified and Appellant has been unable to find any support or description in Obeng to provide for such an interpretation. In fact, even inaccurate Figures 1(*c*) and 1(*d*) include a dark seed layer at the bottom of each via. Furthermore, the Examiner has not provided a shred of explanation as to why as opposed to standard

practices in the art, the copper seed layer would not be deposited and left at the bottom of the trench and via; or how once deposited it would be removed.

Further on, the Examiner states,

> However, assuming a copper seed layer were added to the copper circuit device, it would have resulted in a copper circuit device that was a little bit thicker than before since there would be nothing to delineate thin seed copper layer from the thicker underlying layer. Therefore, *if* it can be read from the specification that there is a teaching of leaving a copper seed layer on the copper circuit device (20/22), the second (20) and first copper (20/22) structures would indeed be in direct contact with each other since copper on copper produces a copper layer that is a little bit thicker. (Examiner's Answer, pages 8-9) [Emphasis added]

In the quote above, the Examiner makes a §103 rejection (*e.g.*, by stating "it can be read from the specification that there is a teaching of..."), and admits that it is not inherent that a copper seed layer be removed from the bottom of the via in Obeng (*e.g.*, because the Examiner admits that the copper seed layer can be left in). Moreover, the Examiner's belief that a copper seed layer deposited in the bottom of the via of Obeng somehow teaches the second and first copper structures in direct contact with each other is belied, as a copper layer between the first and second copper structures would prevent direct contact between them regardless of whether the intervening layer was copper itself.

The Examiner also states,

> As an example, a disclosure of a capacitor, wherein the capacitor dielectric has some inventive feature would not necessarily require a description of forming an upper capacitor plate because one having ordinary skill understands that this is needed. Nor is it necessary to explicitly disclose to one having ordinary skill that a dielectric layer (self-assembling organic film) should not be disposed between layers of an interconnect line, since the line should function like a wire for optimal speed, not several capacitors connected in series. (Examiner's Answer, page 9) [Emphasis added]

The Examiner's example quoted above, with respect to forming an upper capacitor plate, is inconsistent with the Examiner's attempt to argue that Obeng describes removing layers when it does not, for two reasons. If an upper capacitor plate is necessary to provide capacitance, the lack of an upper capacitor plate would

disable the invention. However, according to the Examiner's own admission, the invention in Obeng will function with barrier layer 18 and a seed layer between copper layer 20 and any underlying structure. (Obeng, col. 2, lines 6-14) Therefore, the example quoted above is inapplicable to the issue at hand, which is that a dielectric layer is disposed between copper layers of an interconnect line but is not removed therefrom, as described by and supported in Obeng.

Next, the Examiner states,

> Although the steps of removing a portion of the passivation material and barrier are not explicitly described by Obeng et al., the specification should not be read in a vacuum, but with the level of understanding that one having skill in the art would possess. The feature of not having a passivation layer between the lower copper layer (20/22) and the upper copper layer (22) is inherently disclosed for reasons cited above. Furthermore, since the purpose of the passivation layer is to protect the copper from air corrosion (Co. 2, lines 17-20) and avoid interaction with adjacent dielectrics (Col. 1, lines 33-35), there is no need for the layer between two copper layers. (Examiner's Answer, page 9-10) [Emphasis added]

In the quotation above, the Examiner again admits that Obeng does not explicitly describe "removing a portion of the passivation material and barrier." Moreover, the Examiner's hand waving quoted above appears to be another attempt to assume that a practitioner in the art would assume that something should be done different than what is described in the reference because of inaccuracies in the drawings, and is an impermissible new statutory ground of rejection (MPEP §1208.01; 37 CFR §1.19382). With respect to the assertion that removal of the passivation layer is inherently disclosed, as noted above, the Examiner has proven that such a removal step is not inherent by admitting that the structure shown in Figure 1(*b*) and described in the corresponding portion of the specification in Obeng can be formed. (Examiner's Answer, page 6, lines 15-19, page 8, lines 9-11, and page 12, lines 3-5)

Furthermore, the Examiner's assertion that the purpose of the passivation layer supports that there is no need for the layer between two copper layers is illogical. The protection that the passivation layer provides for the copper from air corrosion includes protection during manufacturing. Therefore, the protective purpose of the passivation layer is not a logical support to removal of the passivation layer. Similarly, the

passivation layer is disposed at the bottom of a via (*e.g.*, intended to be between the two copper layers) will protect verses interaction with adjacent dielectrics, if the bottom of the via formed completely or partially misses the copper layer below and thus is formed totally or partially over adjacent dielectric (a result which often occurs in the art).

In conclusion, the Examiner's wish for a better reference does not cure that Obeng describes: (1) forming via and trenches; (2) deposition of layer 18 on all surfaces of the via and trench (*e.g.*, as shown in Figure 1(*b*) and described in the corresponding text); (3) deposition of a copper seed layer; (4) deposition of copper layer 20; (5) polishing and cleaning of copper layer 20; (6) deposition of film 24; and (7) repetition of the above steps to form subsequent copper layers and vias in trenches, but does not describe removal of any of those layers from only the bottom of a via. Moreover, a practitioner in the art would not assume removal of layer 24, removal of the copper seed layer, and removal of layer 18 from only the bottom of a via but would presume that the layers were inaccurately omitted from portions of Figures 1(*c*) and 1(*d*), or that those figures are not completely drawn. The assertions that Obeng could be a better written patent, or a more successful technology if enhanced by conjurations of the Examiner's imagination should not create matter that is not described or enabled in the reference.

III. Group III Claims

The Examiner states,

> However, the Applicant argues that the seed layer and barrier material are not formed so as to expose the circuit device. The method by which the barrier material and seed layer are formed are only of concern in so far as how they relate to the final structure of the invention when claims are drawn to a product. In other words, in a product claim the determination of patentability is based on the product itself. (Examiner's Answer, page 11) [Emphasis added]

Here Appellant points out that the claim requires that the circuit device at an end of the via be exposed with respect to the seed layer and the barrier material. Or in other words, that the seed layer and barrier material are formed so that neither the seed layer nor the barrier material are disposed at the end of the via between the circuit

device and anything. Thus, Appellant's arguments above with respect to Group I apply to Group III, as well.

IV. Applicability of Arguments

The Examiner recapitulates the arguments addressed above in connection with various other claims or claim groups. In the interest of brevity, Appellant has not done so but submits that the same arguments set forth above apply to each occurrence of the counter argument in the Examiner's Answer.

V. Conclusion and Relief

Based on the foregoing, Appellant requests that the Board overturn the Examiner's rejection of all pending claims and hold that all of the claims of the present application are allowable.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: 9/28/04

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I hereby certify that this correspondence is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Nedy Calderon 9/28/04

Nedy Calderon Date

APPENDIX

CURRENT CLAIMS

12. An integrated circuit comprising:

a substrate having a circuit device;

a dielectric material overlying the circuit device with a via formed in the dielectric material to the circuit device, the via exposing a sidewall in the dielectric material and a surface of the circuit device;

a barrier material substantially lining the sidewall of the via;

a seed layer on the barrier material and substantially lining the sidewall of the via; and

a conductive material directly contacting the surface of the circuit device.

13. The integrated circuit of claim 12, wherein the circuit device comprises an interconnection line.

14. The integrated circuit of claim 12, wherein the conductive material is copper.

15. The integrated circuit of claim 12, wherein the barrier layer comprises an etch characteristic such that the barrier material can be selectively etched in the presence of the seed material.

16. An integrated circuit comprising:

a substrate having a circuit device;

a dielectric material overlying the circuit device with a via formed in the dielectric material to the circuit device, the via exposing a sidewall in the dielectric material and a surface of the circuit device;

a barrier material substantially lining the sidewall;

a seed layer on the barrier material and substantially lining the sidewall; and

a conductive material in the via;

wherein the seed layer and barrier material are formed so as to expose the circuit device at an end of the via.

17. The integrated circuit of claim 16, wherein the barrier layer comprises an etch characteristic such that the barrier material can be selectively etched in the presence of the seed material.